POLICY,
RESEARCH AND DEVELOPMENT

18 SEPTEMBER 1979 (FOUO 11/79) 1 OF 1

JPRS L/8663

18 September 1979

Worldwide Report

TELECOMMUNICATIONS POLICY, RESEARCH AND DEVELOPMENT

(FOUO 11/79)

FBIS FOREIGN BROADCAST INFORMATION SERVICE

NOTE

JPRS publications contain information primarily from foreign newspapers, periodicals and books, but also from news agency transmissions and broadcasts. Materials from foreign-language sources are translated; those from English-language sources are transcribed or reprinted, with the original phrasing and other characteristics retained.

Headlines, editorial reports, and material enclosed in brackets [] are supplied by JPRS. Processing indicators such as [Text] or [Excerpt] in the first line of each item, or following the last line of a brief, indicate how the original information was processed. Where no processing indicator is given, the information was summarized or extracted.

Unfamiliar names rendered phonetically or transliterated are enclosed in parentheses. Words or names preceded by a question mark and enclosed in parentheses were not clear in the original but have been supplied as appropriate in context. Other unattributed parenthetical notes within the body of an item originate with the source. Times within items are as given by source.

The contents of this publication in no way represent the policies, views or attitudes of the U.S. Government.

For further information on report content call (703) 351-2811.

JPRS L/8663

18 September 1979

WORLDWIDE REPORT

TELECOMMUNICATIONS POLICY, RESEARCH AND DEVELOPMENT

(FOUO 11/79)

CONTENTS PAGE

CONTENTS (Continued)

SOVIET-FINANCED COMMUNICATIONS SYSTEM TO BE INSTALLED IN CUBA

Havana PRELA in Spanish 1227 GMT 10 Aug 79 PA

[Article by Isabel Montero]

[Text] The installation of a transmission system by means of a coaxial cable, a project totally financed by the Soviet Union, will place Cuba alongside the most developed countries in the field of long distance communications.

The first installation stage of the line, with over 1,800 km of central cable and branches to 14 provincial capitals and other important cities in the country will be concluded during the first quarter of 1981. It will be the greatest investment ever made in Cuba in communications matters.

The section scheduled for 1978 was 124 percent completed, with the laying of 48.5 km of cable out of the scheduled 38.8 km.

Cuba's development during the 20 years of its revolutionary process has created an increased demand for long distance services and the existing system is insufficient to meet the extensive demands of telephone traffic.

In view of this, the Soviet and Cuban governments, in December 1972 and April 1976, signed economic cooperation agreements for the laying of the communications line by means of a coaxial cable, whose main system comprises two pairs of lines with 10 symmetric conductors.

The coaxial cable is comprised of two conductors: A solid, small-diameter conductor placed within a hollow one which wraps around the first one concentrically.

Some lines connected to the main system use symmetric high frequency cables which (?consist) of various pairs of cables gathered internally, isolated from each other and covered with aluminum and lead. Just like the coaxial cable, the entire assembly is properly protected from external influences.

Both cables will have a continuous gas pressure system in order to increase its dependability, insure control, seal the wrapping and prevent the penetration of humidity during a break.

The cable, whose installation began on 3 May 1978, will comprise the country's main transmission system.

During its first phase of operations, it will have a 920 telephone line capacity and will be able to carry a television signal by means of an integral linkage with the new microwave system. They will act as mutual reserves in case of breaks.

The coaxial cable structure prevents considerable loss of the frequency spectrum and allows a high degree of protection against interference. With the use of conventional methods this number of telephone channels would require 1,920 copper threads.

The completion and implementation of this project called "Cubanacan" will establish the conditions needed for an automatic telephone teleselection system between all the country's important cities and municipalities. It will also increase the number of telephone lines between towns.

This project, which dozens of Soviet specialists have worked on since 1974, includes the installation of 2,179 km of cables through a route consisting of all types of soils.

Besides the use of the cable for telephone and telegraph communications and long distance transmission of data, the coaxial cable will also be used as a reserve for a television channel of the new national microwave system recently installed in Cuba.

Facsimile transmission of the press, which will avoid using air transportation to various regions, is also another of the planned objectives.

The installation of the coaxial cable involves the building of repeating stations every 5.7 km in specially designed underground stations which will not require personnel and are provided with a special alarm system control for the detection and correction of possible errors.

Fourteen semiterminal stations, of approximately 1,500 sq meters each, will also be built. They will be installed in a central building [words indistinct] telephone center and outside multiplex equipment will be joined to the coaxial cable [words indistinct] to this center will be added [word indistinct] telefeeding and telemechanics equipment for the automatic repeating stations.

The [word indistinct] installation of coaxial transmission cable will establish the bases for the future national telex network.

CSO: 5500

TALKS RESULT IN NTT'S CREATION OF INTERNATIONAL PROCUREMENT BUREAU

Tokyo ASAHI EVENING NEWS in English 17 Jul 79 p 5 OW

[Text] Nippon Telegraph & Telephone Public Corp (NTT) has decided to create an "International Procurement Bureau" and "International Section" to handle the participation of foreign companies in bidding for its procurement contracts, which was agreed upon in the recently concluded Tokyo Round of multilateral trade talks and separately held Japan-U.S. negotiations. The two new offices will start business from next January and the International Section will be placed under the direct control of the NTT president.

In accordance with the international code on government procurements which was among the package of agreements initialed after the conclusion of the Tokyo Round talks in April, NTT will procure goods other than electric communication equipment from international tenders starting in 1981. The contracts are seen to be worth 120 billion yen (about $600 million) a year.

Within this month Japan and the U.S. are to resume negotiations on the details of how to draw foreign bidders into the competition for NTT procurements, the broad framework of which was worked out between the two governments on June 2. The framework provides that NTT allow leading foreign electronic and communications makers to participate in the joint development of electric communications equipment with NTT and Japanese companies. If the development work produces results, NTT will award contracts to the participating firms. Depending on the progress of negotiations, NTT will have to open up to 460 billion yen ($2,300 million) worth of contracts for equipment, including some types of mainline communications systems, to foreign bidders.

The International Procurement Bureau will handle procedures for international tenders, from publishing invitations for tenders in English in the OFFICIAL GAZETTE to the drafting, also in English, of contract forms and detailed specifications of equipment to be purchased. It will also handle applications, examine technical and financial credibility of applicants, contact foreign companies participating in joint development and research projects and sales of developed technology to other countries.

CSO: 5500

BRIEFS

CABLE CONTRACT--Kokusai Denshin Denwa Co has received at 31 million yen order for research work for a joint project of the Malaysian and Indonesian governments to lay an undersea telecommunications cable between the two countries, it was announced in Tokyo Wednesday. The Japanese company will undertake the research for selecting the route and oceanographic study necessary for laying the 320 kilometerlong cable between Medan, North Sumatra, Indonesia, and Penang on the western coast of the Malay Peninsula. It will submit its report to the two governments by mid October. [Text] [Tokyo MAINICHI DAILY NEWS in English 23 Aug 79 p 5]

CSO: 5500

JAPAN

FLATS COMPUTER DEVELOPMENT IN PROGRESS AT IPCR

Tokyo NIHON KOGYO SHIMBUN in Japanese 3 Jul 79 p 5

[Text] The Institute of Physical and Chemical Research (chief director, Shinji Fukui) has decided upon conducting more positive research on "formula manipulation computers" which have been developed since fiscal 1979. This is a new type of computer which unfolds formulas using exclusive software and hardware. In fiscal 1979, a budget of 63 million yen initiated the development of three systems called a hashing retrieval system, a data type test system and a logical arismatic operation system. In fiscal 1980, the institute is going to press a demand for more than 150 million yen aiming at a total completion of hardware and partial completion of software, and it plans to make use of the funds at the latest during fiscal 1981. It is very hopeful that this computer will be popularly used in the fields where massive technical computations are required such as nuclear fusion reactors and LSIs.

CPU and its auxiliary systems of a formula manipulation function quite differently from those of existing computers. Hardware is equipped characteristically with features that manipulate formulas collectively as they are and leap over to the next computation, omitting the unfolding of the same computations or the same formulas.

CPU is comprised of four functions, a voluntary digit multifolding operation, a data type test, an automatic table search computation and a logical arismatic operation, and two additional systems, a hashing retrieval and a priority control system, substitute the conventional auxiliary fun functions by means of imaginary tape. The CPU will be operated by a high speed printer, formula input/output data display and type writer for the unfolding of the formulas. Among the three systems started to be developed in fiscal 1979, the hashing system is a device which looks up informations in the intracomputer dictionaries and formulas (table search operation) at an up-graded speed, and it incorporates a high speed memory storage of 1 megabyte (augmented to 3 megabyte by 1981) as a formula data program hanger. The data type program operation test system can speedily test the data content attributable to the exclusive hardware feature which covers the formula manipulation's restriction in that the type of data cannot be determined from the start at the part of the system where meanings of the unfolding formula symbols are interpreted.

The logical arismatic operation system is the part where the forumlas are actually being unfolded, which is equivalent to the CPU of existing computers.

IPCR intends to complete the hardware of these three systems and to systematize the computer only by these three elements. However, due to the necessity to develop the remaining voluntary digit multi-folding operation, automatic table search and imaginary tape systems as soon as possible, IPCR has in mind to request a considerable increase in the fiscal 1980 budget. Especially, it is deemed urgently needed to develop the voluntary digit multifolding system, which is able to increase the number of the operative digits up to hundreds of digits as required and necessary, as well as to develop an imaginary tape system which potentiates massive formula manipulation with its high speed magnetic tape as it imagines containing a 400 megabyte magnetic disc.

This computer is named "FLATS." Three American universities, Cambridge, Utah and Hawaii, have already started joint research on the computer. In the near future, the Ministry of Posts and Telecommunications are planning to realize an exchange of data with the three universities by way of an on-line system using the "Venus" communications line.

Meanwhile, the Science and Technology Agency expects to put the on-line systematization project on the shelf for the time being due to the difficulties associated with the Venus project, but it secured a budget of 150 million yen for fiscal 1980 to concentrate efforts on the completion of hardware and software with a great expectation of the formula manipulation computer.

IPCR estimates that approximately 300 million yen is required for the completion of FLATS. Under the current pace of the research, it may even be completed as early as around the summer of 1981.

8940
CSO: 5500

JAPAN

MITI TO PROMOTE SATELLITE COMMUNICATIONS PACKAGE PROGRAM

Tokyo NIHON KOGYO SHIMBUN in Japanese 17 Jul 79 p 1

[Text] On the 16th, the Ministry of International Trade and Industry disclosed the principal policy for the nurture of the space development industry, which is drawing attention as a leading industry of the 1980s. The pillars of the policy are: (1) installation of a Space Development Industry Division (tentative title) in next fiscal year in order to establish a unitary nurture guidance system; (2) designation of satellite main body, observation-communication-control equipment and launching rocket control equipment as the machinery beneficial under the Law on Temporary Measures for Specified Machinery and Information Industries to devise a positive subsidy policy. MITI is also promoting the idea to launch resource finding satellites with the Agency of Natural Resources and Energy as a key project agency. Including this encouragement, it intends to assist the "Japanese space development industry which has just entered into a practical stage" (leaders of MITI) to gain internationally competitive power by implementing the necessary policies.

In April this year, MITI instituted the "Space Development Problems Research Committee," bringing together the related bureaus and agencies such as the Machinery and Information Industries Bureau, the Agency of Natural Resources and Energy, and the Agency of Industrial Science and Technology, to examine how to carry out the new policy for the space development industry. Since then, it has repeatedly investigated the proposed measures.

The results of the preliminary investigation (interim report) disclosed that the Japanese space development industry had already entered into the practical stage and that it was possible for the Japanese industry to be competitive with the U.S. and European space development industries which had reduced the cost in the past because of the financial investment by the government, if our cost can be reduced by government subsidies in the future.

With this in mind, MITI newly instituted the "Space Development Industry Division" in the structural reformation for the next fiscal year so that the related works within the ministry could be collectively grasped, and it consolidated a policy to use this division as a front office for the unitary space development administration.

Additionally, the satellite main body, other machinery to be loaded for observation, communications and control, and launching rocket control systems are defined as "electronic machinery" and designated as objective machinery beneficial under Article 3 of the Law for Temporary Measures for Specified Machinery and Information Industries. Based upon this, a technical sophistication plan for each machine will be devised, and the following measures for enforcement will be taken: (1) securing of required funds by utilizing loans from the Japan Development Bank (Article 5 of the law concerned), and (2) organizing of indicator cartel which leads to the improvement of production technology and rationalization of production (Article 6), etc.

Simultaneously, the realization of the idea to launch resource finding satellites proposed by the Agency of Natural Resources and Energy, will be hastened. The authority is ready to use the launching itself as a stimulant for the nurture of the space development industry as well as to look into the un-studied fields of satellite technology research and development.

According to MITI's analysis, a total of 2,200 satellites were launched in the world (including 18 Japanese satellites), but the launching number is forecasted to be inflated to 5,000 to 6,000 in the future. Compared to the prospect that only 6,000 aircraft will be manufactured (estimated total cost of 24 trillian yen) in the next 10 years, the space development industry promises a remarkably bright future. Furthermore, it is a typical assembly industry which involves a wide range of other industries and offers a hope for creating massive employment opportunities.

As for our government level participation, the National Space Development Agency has been up to now the center figure which dealt with research and full-scale operation of the space development project. However, now that space development has entered a practical stage and can establish itself as an industry, MITI feels more and more strongly the necessity to draw up a policy to nurture the space development industry from the viewpoint of industrial policy.

Therefore, with the measures taken at this time as the start, MITI intends to institute additionally associations and organizations which will serve as a place for official and private cooperation as well as to look into the ways to offer new government financial assistance to aircraft development and space development.

8940
CSO: 5500

COMPANIES AGREE ON DIVISION OF OPERATING SYSTEM RESEARCH

Tokyo NIKKAN KOGYO SHIMBUN in Japanese 18 Jul 79 p 15

[Text] The basic technology development project for next generation computer systems (basic software and peripheral and terminal equipment) has begun from this month to aim at correcting software quality differences which were the greatest gap between the computers of IBM and national markers. Three companies in charge of the project, Fuji Limited, Hitachi, Ltd. and Mitsubishi Electric Corporation, reached an agreement in conducting basic research of an operating system (OS) primarily at the Computer Development Laboratories (ODL), which was established by the joint capital investment for the development of super LSIs.

Challenged by this movement, the remaining contractors of the project, Nihon Electric Company, Ltd. and Toshiba Corporation of the Nichiden-Toshiba Information System group (NTIS) are expected to follow a similar development system. Once it is decided how to allocate the themes of the development for the OS project (six subjects comprising of basic technology, network management technology, data base management technology, virtual machine technology, super high class language processor technology and Japanese language data processor technology), this case will move forward in concrete form.

The Ministry of International Trade and Industry selected 10 contractors including Fuji Limited, Hitachi, Ltd. and Nihon Electric Company, Ltd, and 12 items as developmental themes which will be promoted by the ministry as a five-year-plan starting this fiscal year. Accepting this work order, the 10 makers established the main body for the project promotion, "Basic Computer Technology Research Corporation," on 5 August (chief director, Kazuo Iwata, president of Toshiba Corporation).

With the starting of the Research Corporation, the 10 makers responsible for the development have been examining the ways to make some sort of "working arrangement" for the development. Three CDL group companies, Fuji Limited, Hitachi, Ltd. and Mitsubishi Electric Corporation, who had kept in common step with one another for the development of a super LSI, have concluded the latest negotiation to work jointly for the basic research for OS development.

8940
CSO: 5500

JAPAN

AIST OPTELECTRONICS INSTRUMENTATION CONTROL SUBCOMMITTEE FOUNDED

Tokyo NIKKAN KOGYO SHIMBUN in Japanese 26 Jul 79 p 2

[Text] The Agency of Industrial Science and Technology instituted an Optelectronics Instrumentation Control Subcommittee (Chairman, Shoji Tanaka, professor at University of Tokyo) as a work group for the Large-Size Technology Development Committee of the Industrial Technology Council in order to prepare a working plan for the optelectronics instrumentation control system, which will be developed at a total cost of approximately 20 billion yen over a period of 8 years starting from 1979. The first meeting is scheduled to be held on the 26th.

The project will be carried out, based upon the Large Project System, as a new project starting from fiscal 1974. Compared to the conventional wire communications method, the project aims to develop a system which can handle a great deal of information generated within a fixed area, such as industrial complexes and large plants, under unfavorable environments using glass fibers instead of communication cables and laser beams instead of electric currents.

The program is not only effective in solving various current pressing issues such as conservation of resources and energy, low pollution and safety in plants, but is also regarded as the first full-scale government policy to assist in nurturing the optelectronics industry, which is reckoned as a dominant knowledge-intensive industry of the 1980s.

As a framework of the development, the Electronics Technology Laboratories of AIST and the private sector will commence research and development work almost in parallel in the first fiscal year 1979, and it is planned that the initiative will be gradually taken by the private sector in tune with the progress of the development. Also, upon starting research and development, it is intended that the developmental themes will be offered for public subscription from the private sector, and the research and development work will be contracted out. Under this policy, it is scheduled that the public subscription offer will be issued in September and the major contract firms will be decided by October.

Nineteen committee members from academic societies, business groups, NHK, Telegraph and Telephone Corporation, etc. participated in the first meeting on the 26th, and discussed the basic 8-year plan and the enforcement plan for fiscal 1979.

8940
CSO: 5500

JAPAN

ITO, IZU ISLANDS LINKED BY SEA-BOTTOM CABLE

Tokyo ASAHI EVENING NEWS in English 6 Aug 79 p 3

[Text] The Nippon Telegraph and Telephone Public Corporation completed the construction of a sea-bottom cable connecting Ito City, Shizuoka Prefecture, and three of the Izu Islands. The islands are Oshima, Miyakejima and Hachijojima.

The cable was constructed to assist communications in the event of a natural disaster.

The cable will increase the capacity of telephone communication between Ito and the three islands threefold.

The corporation has been constructing double-track telephone and telecommunication lines. More than 50 percent of the cables on land have been changed to the double-track system.

The number of telephone calls in the Izu area increases greatly in the tourist season. There are now 12,200 telephones on the three islands.

The telephone office of the Izu Islands had originally planned to use ultra-short waves when all the conventional lines were occupied, but this proved impossible because the frequency of the waves would have been the same as that of telephones used by boats.

CSO: 5500

JAPAN

BRIEFS

OPERATING SYSTEM DEVELOPMENT--Company assignments on the electric computer basic technology development program have been agreed upon. Fujitsu, Hitachi Ltd, and Mitsubishi Electric will carry on the basic investigation on the operating system (OS), chiefly via the jointly-funded subsidiary Computer Development Laboratory (CDL) set up to handle VLSI development. Nippon Electric and Toshiba are expected to maintain their tie-up established under the VLSI program, and are assigned six OS program development topics: basic technology, network management technology, data base management technology, (baacharu) machine technology, very high level language processor technology, and Japanese-language information processing technology. [Tokyo NIKKAN KOGYO SHIMBUN in Japanese 18 Jul 79 p 15]

DDX NETWORK--Nippon Telephone and Telegraph expects to obtain approval from the Ministry of Posts and Telecommunications and start service on a new digital data exchange network in August. Initially, the network will link Tokyo, Osaka, Nagoya, and Yokohama, and packet exchange service will be extended to Sapporo, Sendai, and Fukuoka around October. [Tokyo NIKKAN KOGYO SHIMBUN in Japanese 25 Jul 79 p 15]

FAX EXPORTS TO AMERICA--Hitachi Ltd has concluded a contract with Pacific Communication of San Francisco calling for Hitachi to export to the United States a minimum of 3,000 high-speed (under 1 minute per page) facsimile machines over the next 3 years. Hitachi's analysis of the U.S. facsimile market leads them to believe that they can export 5,000 machines over the 3-year period. [Tokyo NIKKAN KOGYO SHIMBUN in Japanese 1 Aug 79 p 12]

CSO: 5500

SINGAPORE

COMPUTERIZED PHONE EXCHANGES INTRODUCED

Tokyo MAINICHI DAILY NEWS in English 9 Aug 79 p 5

[Text]

Automatic telephony was introduced in Singapore almost 50 years ago. Today, Singapore is among the few countries in the world to have a fully developed automatic telephone network.

Presently, the network consists of approximately a half million working telephones with a penetration of 23 telephones per 100 population.

It is projected that with the rapidly expanding demand for telephone service, the network would grow to 896,000 working telephones with a penetration of 36 telephones per 100 population in five years' time.

This year is the 100th anniversary of telephone service in Singapore. The year will mark a new page in the history of telephone service as Telecoms enters a new era of telephone switching by embarking on a program of full-scale introduction of computer-controlled exchanges.

In this massive program, Telecoms will put into service a staggering figure of 400,000 lines of computer-controlled equipment within the period from 1979 to 1983. The first four computer-controlled exchanges would be ready for service in the fourth quarter of this year, followed by a chain of such exchanges to be located over almost the whole island of Singapore.

New Generation

In this new generation computer-controlled switching system, the centralised computer which serves as the "brain" directs and controls the receiving of dialled digits and route calls to be desired destinations. By means of so called "man-machine communication," Telecoms' staff can request the computer to carry out several functions, for example, change of telephone numbers, change of subscribers' classification, etc. simply by command messages through the teletypewriter. This facilitates exchange maintenance in comparison with conventional electro-mechanical switching systems which will require some physical wiring work. With the advantages of miniatruisation through development in micro-electronics, the new system occupies considerably less floor space. Installation of the new system will be simpler and will involve less wiring on installation site due to less hardware and factory prewiring.

The flexibility of computer-controlled exchanges offers a wide range of applications some of which are still being discovered and developed. Numerous modern voice-enhanced services which are not available in conventional electro-mechanical system may now be achieved through computer program insertion in the new system. These services include abbreviated dialling service, absentee service, call waiting service and other supplementary services which may be made available in future.

Abbreviated Codes

Abbreviated Dialing Service allows push-button telephone subscribers to preregister abbreviated codes of 3 digits to replace lengthy (as many as 16 digits) overseas telephone numbers or those frequently used local telephone numbers.

Once these abbreviated codes are registered, subscribers need only to dial the abbreviated codes when they want to reach the corresponding telephone numbers. Clearly this would benefit all subscribers, especially business subscribers who are likely to have contacts in foreign countries.

As for Absentee Service, subscribers who have been registered for this service at the telephone exchange could activate the service by keying a predetermined code before leaving for vacation. All calls attempting to reach these lines would then automatically be routed to recorded announcements informing callers that the called subscribers are not available at the moment.

Call Waiting Service allows a subscriber who is engaged in a telephone conversation to entertain another incoming call. The subscriber would be informed by a warning tone of an incoming call attempting to reach him. If he wishes, he can place the conversing subscriber in hold condition and attend to the new incoming call by glashing his cradle switch. By the same method, he could alternate between the two parties as often as he wishes.

Although SPC exchanges were first developed and installed in the United States in the mid-1960's, it was only in the last few years that these exchanges were introduced in significant numbers in several developed countries such as Europe, Canada and Japan. Telecoms' early decision to switch to computer-controlled exchanges enables Singapore to join the few countries in the world to modernise its telephone network with this new telephone technology. By the late 1980s, a majority of the telephone switching equipment in Singapore telephone network will consist of SPC equipment.

The introduction of computer-controlled exchanges is an inevitable step towards modernisation and bring us one step closer to the development of a futuristic telecommunication network.

To pave the way for the computer-controlled telephone exchanges, the Telecommunication Authority of Singapore (Telecoms) will also embark on an ambitious seven-year programme of standardising all telephone instruments in Singapore into push-button instruments.

CSO: 5500

ESTABLISHMENT OF PAN-AFRICAN NEWS AGENCY DISCUSSED

Paris JEUNE AFRIQUE in French 8 Aug 79 pp 16-17

[Article by Jos-Blaise Alima: "A Dangerous Undertaking"]

[Text] Dakar will be the home of the PAN-AFRICAN NEWS AGENCY whose first director will be a Nigerian, Sheikh Usmane Diallo, who until now hs been head of the office of the OAU secretary general. The decision was made at the Monrovia Summit (17-20 July). It had taken more than 10 years of negotiations to bring this project to fruition.

The choice of the Senegalese capital did not come about without trouble. Basically, it was the conference of African information ministers at Addis Ababa (4-9 April) which had to pick among three candidates: Kenya, Ethiopia, and Senegal. It had postponed the decision as well as the choice of the director for the summit of the chiefs of state. Indeed, after 4 days of voting and in spite of the fact that Kenya pulled out, none of the candidates still in the running was able to get the required two-thirds majority. Senegal, which pulled ahead with 21 votes against 18 for Ethiopia, had to line up all its heavy guns to win at Monrovia. As for the new director, his presence in the staff of the OAU secretariat-general, on top of a long career in the information field, made him the ideal candidate.

Sheikh Usmane Diallo is 36, with an affable and apparently selfless air; he is one of the young Africans of his generation who know Africa and its problems best. A Nigerian, he spent a good deal of his childhood in neighboring Upper Volta. He got his feet wet in journalism in France. After getting a law degree, he registered at the CFJ (Journalist Education Center) on Louvre Street before taking a course at the OCORA (Radio Cooperation Office), two schools from which the first generations of African journalists emerged.

Sheikh Usmane Diallo worked at OCORA for several years as sports reporter. Since sports were his specialty for a long time, it is not astonishing that he was asked by Jean-Claude Ganga to run the press service of the CSSA (Higher Sports Council in Africa) at Yaounde. He made his mark there as a charming personality and a conscientious journalist and he left a false impression of nonchalance. When he returned to his home country in 1972, it was predicted that he would have a brilliant political career because, among other things, he came to be the protege of Boubou Hama, at that time president of the National Assembly. But Diallo preferred the complexity of international organizations to the meanderings of local politics. He therefore joined the OAU and was assigned to the Niamey bureau. Parallel to that, he tried to get into publishing and publicity but without any great success. It is true that the Nigerian market is not yet ready for this kind of activity.

When the military seized power in April 1974, the name of Sheikh Usmane Diallo was often whispered in connection with running the Information Ministry.

Once again, the rumor turned out to be wrong. In 1975, he once again packed his bags and left Niamey. This time he was headed for Addis Ababa where William Eteki A. Mbumua, who had just been elected OAU secretary general, asked him to come to run his office. He remained there four years, including one year with the current secretary general, before being called upon today to assume other functions, as we just said.

But in returning to his first love, journalism, nobody is really giving him a big present. This paradox is not quite apparent however. Information technicians who have been charged with setting up the PAN-AFRICAN NEWS AGENCY, are the first not to believe in that. Is that so astonishing? The complexity of problems and the concepts which the African regime have regarding information and liberty--including freedom of the press--make this a rather perilous, if not suicidal undertaking. If we put the technical aspect aside, which is slated to undergo evolution as a function of the agency's material and financial resources, we face the collection and dissemination of news, something which cannot be done without causing some wry faces. It is undoubtedly because Senegal is the most liberal among the French-speaking African countries that its capital was chosen as the headquarters of this new agency. We must also note that there are also five regional pools (Zaire, Nigeria, the Sudan, Zambia, and Libya) from which news will be transmitted. It is known that the OAU member states do not belong to it as a whole but only individually. They will be tempted to consider the agency as a national undertaking which they have the right to look into. What will happen when it comes to giving information on Equatorial Guinea or the Central African Empire, to mention just two examples? No African leader wants to have his country's image tarnished abroad. There would then be a great temptation to perpetuate a temptation that has taken hold in African institutions: The failure to pay dues as a prelude to simply staying away and returning to isolation. The estimated budget for the start-up phase, which is to begin on 1 October, has been estimated at $1.75 million. It remains to be seen whether, to 3 months from now, this amount of money will indeed be available those who are responsible with setting the agency up. The other sensitive point concerns personnel recruitment, especially journalists. Will the director be given a free hand in assuring competence and efficiency? or will each country want to assign its own civil servants who will have to be responsible to it? In this latter case, one cannot really see the need for creating a PAN-AFRICAN NEWS AGENCY if it is merely to have the role of disseminating official communiques. The first director of pan-African information will have to fight a battle to make the agency credible. That of course is also true of the four major international agencies (AFP [French Press Agency], Reuter, UPI, Associated Press) which today serve as reference and hold an authoritative position.

5058
CSO: 5500

ERRATUM: Please substitute this corrected version of article which appeared in JPRS L/8584, 23 July 1979 (FOUO 9/79) of this series pp 8-19.

USSR

ESTABLISHING THE MAXIMUM CAPACITY OF GEOSTATIONARY ORBITS

Moscow RADIOTEKHNIKA in Russian No 4, Apr 79 pp 5-12

[Article by L. Ya. Kantor: "Concerning an Evaluation of the Maximum Capacity of a Geostationary Orbit"]

[Text] The problem of the efficient utilization of a geostationary orbit for communications through the use of artificial earth satellites is drawing wide interest amongst specialists insofar as serious difficulties exist in the disposition on orbit of new communications satellites. This problem was examined in detail in the materials of the CCIR [International Consultative Commission on Radio Communications] Research Committee [1].

It appears interesting if only to evaluate approximately the limit to which one may attain within the bounds of technological progress the capacity of all satellite communications systems, the satellites of which are positioned as densely as possible in geostationary orbit.

This value--we shall call it the maximum capacity of a geostationary orbit C_{go}--may be determined through the fundamental hypothesis that the energy resources of each satellite communications system are sufficiently great so that its own noise (both heat and nonlinear) is negligible compared to the interference from neighboring systems. In other words, this hypothesis means that the maximum capacity of each system is totally determined by the interference from neighboring satellite communications systems. Such a trend is already developing in practice: the CCIR upon the initiative of the USSR adopted a recommencation concerning increasing the allowable noise from neighboring systems with a corresponding decrease in the system's own noise [2]. An analogous hypothesis is given in [3].

The present day limitation for current density created by AES's at the earth's surface through an efficient dispersion of the energy of the carrier does not eliminate the given hypothesis.

We shall accept that AES signal separation by polarization is utilized and that this allows a two-fold utilization of the frequency band and thereby double value of C_{go} (we shall define the corresponding coefficient as K_{band}; $K_{band}=2$). It should also be proposed that the efficient (planned) arrangement of satellites in orbit be accomplished so that the AES positioned alongside service as well as possible the far off zones distributed on the earth's surface and that the beam patterns of the AES antennas correspond to the maximum to the serviced territories. A detailed analysis of that which has been attained thanks to this success seems superfluous here because of the necessity to make a number of hypotheses concerning the configuration of the zones being serviced and other parameters of the systems. Nonetheless, experience in the development of a plan for satellite television broadcasting within the 12 GHz band which was adopted by WARC-77 allows for the acceptance as a rough evaluation a two-fold advantage according to this principle ($K_{plan}=2$).

For the conduct of specific calculations it was accepted that the entire band being used by the system be divided into a number of transmitter-receiving trunks with an identical pass band (for example, $\Pi_{trunk}=35$ MHz, since this now exists within the majority of satellite communications systems, and which overlap the entire band of the separated frequency spectrum without frequency gaps.

It is proposed that within each trunk, a message is transmitted in a single-signal mode without a distinctive satellite communications systems of multi-station access. It is not necessary to understand this hypothesis literally; it means that multi-station access is accomplished without losses. Actually, the systems being created now for temporary multi-station access yield very small losses in throughput capacity in comparison with the single-signal mode [4].

Finally to simplify the analysis for the present we shall make a hypothesis concerning the uniformity of all interacting satellite communications systems. It is normally considered that in this case the capacity of the orbit is maximum [1]. This question will be discussed in greater detail below.

The necessary separation between neighboring satellites for closely positioned ground stations of neighboring systems is determined by the directivity of the ground-station antenna*. Gain of the antenna outside the main lobe of the beam pattern in accordance with the CCIR Recommendation No 465-1 is usually made by the equation

$$G_{db}==32 - 25\lg\theta, \quad 1° < \theta \leq 48°, \tag{1}$$

*The directional characteristics of onboard AES antennas appear only through an efficient selection of the servicing zones and AES positions, and are taken into account by the previously introduced coefficient K_{plan}.

where θ is the angle taken from the axis of the main antenna beam.

However, considering the success in the development of antennas with a remote (nonaxisymmetric) irradiating unit where the level of the side lobes is significantly reduced (for example, the antenna of the Japanese national satellite communications system has a range of 11-14 GHz [5]), for future evaluations we should adopt a more progressive relationship, for example

$$G_{db} = 22 - 25 \lg\theta. \quad (1')$$

In the area of the main lobe [6]

$$\frac{G}{G_0} = 2\frac{I_1(kR\sin 2\theta/\theta_{0,5})}{kR\sin 2\theta/\theta_{0,5}}. \quad (2)$$

where I_1 is the Besselian function of the first order from the actual argument; $k = 2\pi/\lambda$; $\theta_{0.5} = 70\lambda/D$ · is the angular width of the main antenna beam at the half-power level; R is the radius of the antenna aperture; Go is the maximun antenna gain (in the direction of the axis of the main beam) which is determined by the usual formula

$$G_0 = q\frac{\pi^2 D_A^2}{\lambda^2}, \quad (3)$$

where D_A is the diameter of the antenna reflector (usually $D_A = 12 \div 32$M); λ is the wave length; and $q \approx 0.5 \div 0.7$ is the usage coefficient for the surface of the antenna aperture.

Finally, to complete the calculations we must in some manner determine the antenna pattern between the main beam and the region where (1) - (1') are accurate. Taking into account the instability of the first null's position and its "loading" due to the structural imperfection, as well as keeping in mind [5], the possibility of reducing the maximum of the first side lobe to minus 30 dB, we shall combine the regions described by the formulas (2) and (1') and by the horizontal segment at the minus 30 dB level. We shall accept the derived beam pattern (figure 1) for all future calculations. The author does not insist on the pattern in figure 1; for other beams patterns the calculations may be simply corrected with the aid of the ratios presented below.

When performing the calculation, one should take into account interference not only from the pair of closest satellites but also from those more distant. In the hypotheses made above concerning the uniformity of satellite communications system, it is sufficient to consider a second pair of satellites. In the area where the ratios (1) and (1') function, the second pair of interfering satellites increases the interference by approximately 18 percent; in the region of the main beam the interference from the second pair is negligible; and in the horizontal part of the pattern is equal to the interference from the first pair of interfering satellites.

All that has been stated is sufficient to calculate C_{go} if we still select the threshhold interference value in the channel of neighboring systems and determine a technique for calculating the required ratio of signal power to interference at the ground-station (ρ) transmitter input.

We shall examine the beginning of the simplest and widely used variant of multichannel telephony signal transmissions in a similar format with the usual frequency density and frequency modulation. In this case, the limit of the interference value from the neighboring systems should be considered as the norm for the total noise power in a telephone channel--10,000 picowatts.* The required value ρ may be calculated for an above threshhold mode according to the method developed in [7], using the formula for interference power (at the point with a zero relative signal level);

$$P_{noise} = \frac{\Delta F_k k_n^2 10^9}{\rho F_2 B^2(\Omega)} \left(\frac{F}{\Delta f_k}\right)^2 F(\Omega, \delta\omega), \qquad (4)$$

where ΔF_k == 3.1 kHz is the telephone channel band; k_n ==0.75 is the psophometric coefficient; F_2 is the upper frequency for the spectrum of modulated

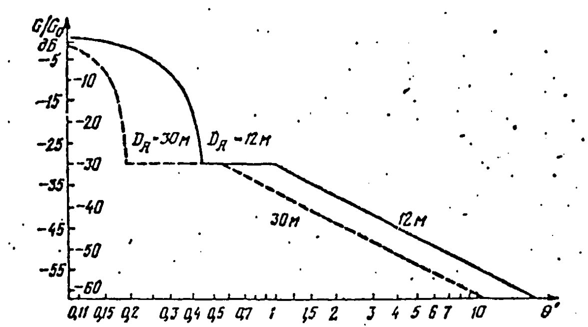

Figure 1

signal and interference frequences; F is the frequency of the modulated frequencies' spectrum which corresponds to the channel in which the measurement is taken; in the upper channel $F=F_2$; B (Ω) is the coefficient which takes into account the influnece of the standard linear preselections which have been received through the transmission of the multichannel telephony along radio relays and satellite communications system with $\Omega = 2\pi F_2$ $B^2(\Omega) = 2.5$; $\Delta f_k'$ is the effective frequency deviation which corresponds to the measured level of a single telephone channel; $F(\Omega, \delta\omega)$ is the function calculated by means of a spectrum package of useful and mixed signals with a mutual misalinement which is dependent on the effective modulation index M_o of the

*Apparently, in practice after the deduction it is difficult to eliminate the channel imaging equipment noise $P \approx 2500$ Wt signal and interference. Function graphs F (Ω, $\delta\omega$) were given in [7]; and we shall calculate it for the case where $\delta\omega$=0, which corresponds to the continuous pursuit of spectra in useful and intermixed systems, although when intelligently planning the frequency schemes of neighboring systems one may through $\delta\omega \neq 0$ somewhat diminish the influence of the interference.

To determine the necessary value ρ, there should be a two-fold decrease in the value 10,000 picowatts which has been substituted in the left portion of (4) in order to make allowance for the interference from a neighboring disturbing AES which has been positioned on another side; we should also take into account interference from a second pair of more distant AES with the aid of figure 1, as has already been described, and finally, interference from the region both below and above. Interference which arises in the regions from below-upward, and from above-downward in idential systems, may be considered as approximately identical and added together in terms of power as a result of which P_{noise} should be decreased two-fold. Thus, for the angular dispersions $\theta > 1^0$ we should substitute the value $\frac{10000 - P_{noise}}{2 \times 2 \times 1.18}$ picowatts in the formula (4), and for $\theta > 1^0$ the selection is accomplished with the aid of figure 1. We shall perform the calculations for the upper channel, since, as was shown in [7], the transient noise in this channel which has been caused by radio interference is close to the maximum (this solution is the result also of the fact that in the upper channel all other forms of interference are usually maximum, including those nonlinear).

Let us accept for the first evaluation that in each trunk there are formed N=1920 channels (F_2=8525 kHz) with Δf_k = 140 kHz which is realized in practice as a variant of a system with a number of channels close to maximum: then, using (1) - (4), we derive that the dispersion between the neighboring AES should amount to $\theta \approx 1.9^o$, but taking into account the allowable instability of the AES position in orbit $\pm 1.1^\circ \theta_i \approx 2.1^\circ$. Further, using the obvious ratio

$$C_{go} = \frac{N}{\pi_{trunk}\theta_I} K_{band} K_{plan} \quad \frac{\text{channels}}{\text{MHz . deg}}$$

we derive $C_{go} \sim 105 \frac{\text{channels}}{\text{MHz} \cdot \text{deg}}$

Thus, in the 500 MHz band and on the actually utilized orbital curve of 180° one may distribute satellite communications system with a total capacity of $9X10^6$ channels. These results were derived through application of antennas with a diameter of D_A = 12 m ($G_o \approx$ 52 dB); if D_A = 30 m the capacity of the orbit is approximately doubled.

Since the objective of this article is to evaluate the limit of the capacity of the orbit, it makes sense to examine the variant of an ideally corrected (by amplitude-frequency and phase-frequency characteristics) transmission channel which makes it possible to apply the increased deviation value for the frequency on the channel Δf_k. The limiting factor for increasing Δf_k in this case will be the appearance of the natural noise in the channel which is caused by cutting off a part of the spectrum; this phenomenon is examined in detail in [7].

According to the method in [7] for a system with FM and frequency-division multiplexing with the number of channels in the trunk N=1020, 1920 and 3600, the relationship of the noise in the channel arising within a path with a limited band as a result of frequency deviation on the channel Δf_k was examined. This relationship results in the ratio

$$P_{noise} = k \frac{N_\Delta}{\Delta f_k^2} \qquad (6)$$

where $N_\Delta = \int_{q_\Delta}^{q_\Delta + b} g(q)g(b-q)dq$ is the convolution of the spectra for the FM signal $W_{FM} = g(q)/\Omega_2$ which is also the function Δf_k, $q=\Omega/\Omega_2$, $\Omega_2=2\pi F_2$, $q_\Delta = \Pi_{trunk}/2F_2$, $b=\Omega_k/\Omega_2$, and Ω_k is the channel frequency in which the noise is calculated.

Calculation of the required dispersion angle between the AES in orbit may now be accomplished through the formulas given above and in figure 1. Thus, it is possible to identify the optimum value Δf_k for an ideally corrected path and which corresponds to the maximum orbital capacity. For this, given the value of Δf_k, we determine P_{noise} with the aid of (6). Then, as the limiting value for transient interference from neighboring AES's we use in place of 10,000 picowatts the value $P'_{noise} = 10{,}000 - P_{noise\,(n)}$. Increasing Δf_k raises the noise stability of the communications system and permits a decrease in the angular dispersion, but it increases $P_{noise(n)}$ and thereby, while decreasing $P_{noise(n)}$ it acts in the opposite direction; moreover N_Δ is increased, and consequently $P_{noise(n)}$ is also.

The optimum for N-1920 channels is achieved through $\Delta f_k \sim 700 \div 800$ kHz by the dispersion angle between the neighboring AES $\theta_1 = 1.05°$(taking into account the instability θ_1-1.25°). The capacity of the orbit, therefore, reaches C_{go}=175 channels MHz · deg.

The optimum modulation index turns out to be sufficiently great (especially with less than 1920 channels), but the allowable noise is relatively great; therefore, the method for calculating the noise due to limiting the path band was developed in [7], apparently, imprecisely since it did not take into account the "liminal" effect which is connected with the formulation of a large phase error and suppression of the signal at the moment when the deviation for the instant frequency exceeds one-half the band of the path. In this case, the signal deviation should be limited by a value such that the probability of the excursion of the instant frequency beyond the limit of the band path approaches zero.

For the number of channels within the trunk N=1020, 1920 and 3600 the capacity of the orbit C_{go} turns out to be approximately identical, since the growth in the number of channels within the trunk is accompanied by a significant decrease in the optimum frequency deviation at the Δf_k channel and, as a result, with an increase in the angular dispersion of the neighboring AES.

In this manner, the assessment of limiting capacity for telephone communications satellite systems with FM and FDM should be calculated as the value from 105 to 175 $\frac{\text{channels}}{\text{MHz}\cdot\text{deg}}$ (for systems with an ideal correction of the path and an optimally increased frequency deviation).

Now we shall turn to an analysis of the signal transmission variant within a discrete format with the aid of a more widely applied, in this case, phase modulation. As before, we shall assume that the inherent noise in the system is insignificantly small. An evaluation of the allowable ratio of useful and interfering signals may be made on the basis of an allowable probability value of the error during reception.

For the sake of simplicity we shall perform this evaluation initially for a situation with only two interfering signals from two of the closest satellites. Thus the error through the elementary reception of data with the simplest solution arises only in the case if (see figure 2) the total interfering vector (U_1+U_2) intersects the line passing under the ϕ_0 angle to the vector of the useful signal U_0 and separates the regions of the neighboring discrete phase values, that is

$$2\phi_0 = 2\pi/n, \tag{7}$$

where n is the number of modulation phases.

In other words, projection of the vector (U_1+U_2) in the direction perpendicular to the dividing line for initiating the error should exceed the value $U_0 \sin\phi_0$. The following equation corresponds to this

$$U_1 \cos\varphi_1 + U_2 \cos\varphi_2 > U_0 \sin\varphi_0 \tag{8}$$

and with $U_1=U_2$

$$\cos\varphi_1 + \cos\varphi_2 > \frac{U_0}{U_1} \sin\varphi_0. \tag{8'}$$

It is apparent that there exist two (identical in area and shape) regions of values ϕ_1 and ϕ_2, where the condition (8') is fulfilled and the probability of error may be determined as the ratio of the area for these regions (cross-hatched in figure 3) to the total area $4\pi^2$ (in the simplest hypothesis for the uniform distribution of phases for interfering signals), that is

$$P_{error} = \frac{2}{\pi^2} \int_0^{\arccos \frac{U_0 \sin\varphi_0 - U_1}{U_1}} \arccos\left[\frac{U_0 \sin\varphi_0 - U_1 \cos\varphi_1}{U_1}\right] d\varphi_1. \qquad (9)$$

Through the small P_{error} which interest us and, consequently, the small ϕ_1 and ϕ_2, the equation $\cos\phi_1+\cos\phi_2=$const most closely corresponds to the circumference, and therefore instead of (9) the calculation may be performed by the simple formula ($U_1=U_2$):

$$P_{error} = \frac{1}{2\pi}\left[\arccos\left(\frac{U_0 \sin\varphi_0}{U_1} - 1\right)\right]^2. \qquad (10)$$

With the small P_{error} from (10) it follows that $\frac{U_0 \sin\varphi_1}{U_1} \to 2$ or

$$U_1 + U_2 \leqslant U_0 \sin\varphi_0. \qquad (11)$$

Thus, with four-phase ($N=4$, $\phi_0=\pi/4$ and $P_{error}=3\cdot10^{-7}$ through the calculation according to (9) or (10) we derive $U_0\sin\phi_0/U_1=1.999999$. It is apparent that for an evaluation of C_{go} one may utilize (11). Through the activity of four interfering signals one may apply the generalized ratio

$$\sum_{k=1}^{k=4} U_k \leqslant U_0 \sin\varphi_0. \qquad (12)$$

From (12) for n=4 we obtain $\Sigma U_k \leqslant 0{,}7 U_0$.

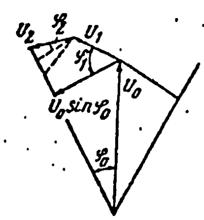

Figure 2.

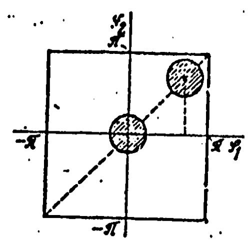

Figure 3.

Since (12) corresponds to the probability of error $P_{error}\to0$ and the relative interference level from neighboring AES's in the segment from below upwards is approximately the same as in the segment from above downwards, then the noise accumulation in these two segments may be taken into consideration (keeping in mind that recording of the signals is being performed onboard the AES).

Then for four identically orbited and similar interfering AES's the relative interference level from the closest pair should amount to ~-9.8dB, and the necessary dispersion between the neighboring AES's is approximately $\Theta=0.33°$, and taking into account instability $\Theta_1=0.53°$.

In the earlier adopted band of the 35 MHz trunk when n=4 one may transmit practically on the order of 60 megabits, or nearly 1000 telephone channels (normally 64 kilobits are expended on each channel). Then the limiting capacity of a geostationary orbit, as determined by (5), is C_{go}=216 channel/ MHz X deg, or C_{go}=12.9 megabit MHz·deg. Application of a more multi-phase modulation (n>4) permits an increase in the speed of transmission within each trunk (proportional to $\log_2 n$), but as a result of the decrease in ϕ_0 according to the formula (7) an increase in ρ and the angular dispersion between AES's is required. The calculation showed that the maximum is achieved when n=16 and is C_{go}=22.1 megabits/MHz·deg, or 368 channels/MHz·deg.

When using delta modulation one may use up only ~30 kilobits per channel (although a telephone channel, in so doing, is not totally universal), and then the evaluation of C_{go} according to the number of telephone channels is doubled. The permutation of the maximum capacity of the orbit when n=16 is determined by the accepted antenna beam pattern and its diameter.

For example, for the worst antenna [the equation (1)] the maximum is achieved when n=8.

It is apparent that the capacity of a geostationary orbit in the transmission of signals in digital form is significantly greater than in analog form. This is caused basically not by an increase in the capacity of each trunk and satellite but by a decrease in the dispersion between them. One should also emphasize that the initially performed hypothesis concerning the absence of losses as a result of multi-station access is successfully approximated only through the transmission of signals in digital form.

In the previous statement not included was the application of interference-free coding, modulation of the carrier simultaneously in phase and amplitude, reception "as a whole" and other techniques whcih are enhancing the throughput capacity of the communications system. A specific analysis of these measures is very time-consuming; however, one may most simply evaluate the limit through optimal processing of the transmitted signals and through noise-stable reception if one is to propose that a series of several (four or more) interfering signals modulated simultaneously in amplitude and phase is sufficiently close to the normal noise fluctuation with normal dispersion. Then to calculate the throughput capacity of the trunk under the influence of interference from neighboring satellites with a total power capacity of P_{noise} one may utilize the formula of C. Shannon

$$C = \Pi \log_2 \left(1 + \frac{P_{sig}}{P_{noise}}\right). \tag{13}$$

Since (13) determines C when the probability of error approaches zero, then we can ignore the influence of the segment from below upwards where the conditions are no worse than in the segment from above downwards, as was done above. Assigning different values to $\rho = P_{sig} / P_{noise}$, we may use (13), (1'), (2), (3) and (5) to determine the appropriate dispersion between adjacent satellites and then C_{go}. The optimum is observed approximately when $P_{sig}/P_{noise} \approx 250$, angular dispersion θ=0.44°, θ_1=o.44° and amounts to

$$C_{go} = 50 \text{ megabits/MHz}\cdot\text{deg}; \qquad (14)$$

Thus, the possible advantage from the application of optimal transmission and reception methods is accomplished (by more than two times), but it is not as great as usually occurs when comparing actual and potential communications channel capabilities. This is explained by the more "harmful" character of the noise interference characteristic. The evaluation according to (13) is less than the previous one and depends on an insufficiently rigid fulfillment of the accepted condition of an infinitely large energy resource for each system, since the addition of even a small portion of the inherent noise temperature with a normal distribution sharply reduces the evaluations made with the aid of (4) and especially (12), and has little influence on the evaluation according to (13).

It is possible to exceed the evaluation in (14) by: a greater than two-fold utilization of the band with the assistance of planned use of the orbit and high-directional onboard antennas ($K_{plan} > 2$); the application of ground antennas of with a better directivity pattern than in figure 1, or antennas of greater diameter; and the coordination (in particular, synchronization) of signals of neighboring satellite communications systems and the use of this apriori information during reception.

In conclusion, we shall stop on the particular question which has a rather theoretical meaning concerning the advisability of adopting similar satellite communications systems.

Usually it is proposed that system uniformity (according to sensitivity towards interference from neighboring systems) corresponds to the maximum capacity of the orbit [1]. However, it should be pointed out that the capability for the future increase of C_{go} is precisely through the application of nonuniform systems and a compensation method for suppressing noise. As was shown in [8], this method (which was accomplished by a adaptive system with an optimum linear filter based on the criteria of a minimum total of signal and interference power at the compensator output) allows for the attainment of a signal/noise ratio

$$\rho_{output} = 1/\rho_{ref} \qquad (15)$$

where ρ_{ref} is the ratio between signal/noise, which was received at the reference input (that is at the output of an auxiliary receiver intended for the separation of signal interference).

In other words, for good interference compensation it is necessary to have a high signal/noise ratio (that is, cleaner interference) at the receiver interference output. If the ground stations are to be equipped with receivers for the signals of a neighboring system (for example, with the assistance of an auxiliary irradiator on the very same reflector which forms a displaced beam), then through uniform systems the signal/noise ratio at the output of basic and compensating receivers is identical and the compensation method gives no advantage whatsoever.

If then we are to adopt the alternating of systems with a diversity in the power of neighboring satellites as a large number times M (figure 4), then, apparently, at the output of the ground receiver the systems with powerful satellites the signal/noise ratio grows to M times (to the value ρ_1), which permits a corresponding increase in its capacity. Therefore, at the ground station of a communications system with AES's having low power the signal/noise ratio ρ_2 is small, but accepting the method for compensating interference from neighboring AES's with respect to (15) and within this system the ratio signal-noise may be increased M times to the value $1/\rho_{ref} \to \rho_1$.

If M>>1, then the interference prevails over the second pair of AES's having the very same power, as well as the AES's of the useful system, and the compensating reception cannot offer any kind of advantage. It is apparent, therefore, that the number of AES's on orbit (and its capacity) may be increased with the aid of non-uniform AES and compensating reception no greater than two-fold.

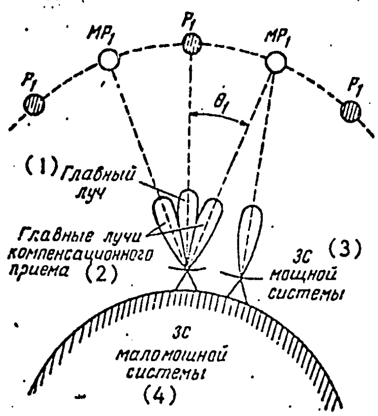

Figure 4

Key:
1. Main beam
2. Main compensating reception beams
3. Ground station of high-power system
4. Low power ground-station system

Through the adoption of non-uniform systems the condition $\rho_{ref}/\rho_2 \gg 1$ should be maintained on all stations within the limits of the zone being served by the low-power AES where an increase of ρ necessary.

Note that the useful indicator of this work is the capacity of the orbit (the number of channels or binary digits per MHz and per degrees) does not totally characterize the utilization efficiency of the orbit; for such an evaluation one should use a more general indicator--kilometer channels for an equivalent ground network [9].

BIBLIOGRAPHY

1. CCIR, 14th Plenary Assembly, Kyoto, Doc. 4/1042-E, Report 453-2, 1978.

2. CCIR, 14th Plenary Assembly, Kyoto, Doc. 4/1035, Recommendation 466-2, 1978.

3. "Comparison and Optimization of Techniques for the Separation and Modulation of Signals Within Radio Networks. EKSPRESS-INFORMATSIYA," PEREDACHA INFORMATSII, No 23, 1974, or D. Juilwijk PHILIPS RES. REPST., vol 28, No 4, 1973.

4. Kantor, L. Ya., and Tsirlin, V. M. RADIOTEKHNIKA, vol 32, No 11, 1977.

5. Chu, T., and others "BSTY". vol 57, No 5, 1978. See also Nippon Telegr. and Teleph. Public Corp. "Offset Cassegrain Antenna for Earth Station."

6. Askinasi, G. B.; Bykov, V. L.; and others. "Osnovy tekhnicheskogo proektirovaniya sistem svyazi cherez ISZ" [Engineering Planning Principles for Communications Systems Through Satellites], edited by Fortushenko, A. D., SVYAZ', Moscow, 1970.

7. Borodich, S. V., "Iskazheniya i pomekhi v mnogokanal'nykh sistemakh radiosvyazi s ChM" [Distortion and Interference in Multi-channel Systems for Radio Communications With Frequency Modulation], SVYAZ', Moscow, 1976.

8. Undrou, B.; Glover, D.; and others "TIIER", vol 63, No 12, 1975.

9. Kantor, L. Ya. ELEKTROSVYAZ's, No 1, 1976.

9082
CSO: 5500

END